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Flora of Lehigh County, Pennsylvania—I

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INTRODUCTION

In recent years, the phase of botany having to do with plant distribution in all its relations has had such generous attention that while formerly local lists were received with a certain degree of tolerance, now they are not only sought for but desired. Botanical literature is full of treatments of the larger areas, and generous acknowledgment to local floras is the usual rule. In this paper and what is expected to follow later under the same head, the writer desires to record for the benefit of those who can use them certain observations with regard to the flora of that portion of his working field with which he is most intimate.

Lehigh County is one of a group of counties in Pennsylvania which share the Kittatinny Mountains as a boundary. The northern boundary of the county follows the crest of this range westward for a distance of sixteen miles to corner with Berks. The western boundary is a straight line of twenty-nine miles extending south by east and is shared in common with Berks and Montgomery. On the south is Bucks County. On the east, Lehigh County shares with Northampton the Lehigh River as far as Catasauqua. The Second Geological Survey of Pennsylvania (1:D 3) well characterizes the county as "a nearly rectangular figure leaning northwest." It includes an area of three hundred and sixty-four square miles.

The Kittatinny Range, also known as the Blue Mountains,

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is a part of the Appalachian chain and in the county trends to the southwest from Lehigh Water Gap, with an even crest at an altitude of about 450 m., broken only by a few depressions and one noteworthy prominence, Bake-oven Knob, 473 m. The Shawangunk* sandstone and conglomerate of which this range consists belongs to the Lower Silurian Period of the Paleozoic Era. Only the south slope of the range is included within the county. Unlike the north slope, which is long, the south slope is short and steep, from a comparatively sharp and narrow crest, and almost uniformly rocky. A plateaulike shelf, composed largely of fallen talus from the mountain and resting on the underlying shale formation, leads gently away from this steep slope. Many small streams rise here, and there are occasional areas that are marshy or boglike in character, but usually of very limited extent. In the vicinity of the Bake-oven, there arise Trout Creek draining into the Lehigh at Slatington, the Jordan Creek draining into the Lehigh at Allentown, and the Antelawny draining into the Schuylkill in Berks County.

Approximately twenty miles to the south are the South Mountains, or Durham and Reading hills, usually known locally as the Lehigh Mountains. This is a range of gentle slopes and rounded knobs with shallow intervening valleys quite unlike the long sharp-crested and rocky mountains to the north. In general within the county the north slopes are rather longer than the steeper south slopes, but small streams heading in the moist areas of marshy or boglike character in the shallow valleylike depressions between the ridges of the crests are found on both slopes. With the exception of some of the knobs, the average altitude is about 275 m. In New Jersey the region corresponding to this geological formation, which is topographical as well, is called the Highlands and from Pennsylvania southward forms a part of the so-called Piedmont Plateau.

In the vicinity of these hills are outcrops of the Hardyston quartzite and sandstone of the Cambrian Period, which overlies the Pre-Cambrian rocks of which these hills are largely made up.

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*These rocks have been known as the Oneida and Medina sandstones and conglomerates but Dr. Benjamin L. Miller, of Lehigh University, has recently referred them to the Shawangunk and this later term is here used through his courtesy.

Still farther south, approximately five miles, are the foothills of the South Mountain range, really a part of the main range which has here spread out to include the considerable area of the Saucon Valley. These hills are practically a continuation of that part of the South Mountain range which in Bucks County is known as the Durham Hills. To the southwest in the county these hills are more closely grouped and in this formation trend southwest into Berks County as far as the vicinity of Reading. In Cumberland County, where this range practically reappears and is properly called the South Mountains, it is a portion of the southern boundary of the Great or Kittatinny Valley.

The greater part of the surface area of Lehigh County lies between these ranges in the Great or Kittatinny Valley. This long and broad valley, like the Kittatinny Range which it parallels, is an important geological as well as topographical feature in the East. The geological formations are of the Cambrian and Ordovician periods of the Paleozic Era, and although they may be subdivided into various minor formations, fall naturally into two well marked divisions, lithologically as well as topographically, which may be characterized as the "slate" or "shale" and the "limestone" regions. The shale occupies the greater surface area and overlies the limestone, which in turn overlies the Hardyston sandstone and quartzite that outcrops in the vicinity of the South Mountains and occupies relatively little surface area.

This shale region differs very materially from the limestone region to the south. Its water courses greatly exceed those of the limestone region numerically, and by the mechanical cutting down of the hills have created numerous wide ravines with sharp rises to the uplands, creating a characteristic topography differing greatly from that of the limestone region to the south.

As the shale region is approached the line of contact with the limestone plain is apparent in the landscape. Within the county this line is irregular on account of shale ridges that extend into the limestone region and widen the shale region westward as they join that formation in that direction. For this reason the shale region along the Lehigh River is about eight miles wide, but at the Berks County line it is twelve and one-half miles wide. Just south of the Kittatinny Range are high hills of approximately

240 m. or occasionally higher, increasing in altitude westward beyond the Jordan Creek, where in Lynn Township they receive the name of Shochary Ridge, and culminating in the Spitzberg, 330 m. The effect of these ridges on the drainage of the northwest portion of the county is marked. Still farther westward beyond the county these ridges rise as high as the Kittatinny Range. In general the entire topography of this formation is characterized by a multitude of short valleys and rounded hills, which range in altitude from less than 180 m. to the maximum above quoted. The average altitude of this "plain," which it really is, must be approximated from these elevations but can be stated at about 210 m.

The limestone region in general is about 60m. lower than the shale region and is characterized by broad river valleys and more gentle rises from the streams to the comparatively even uplands. The resulting topography is like a gentle plain in appearance when viewed from the South Mountains and differs markedly from the rugged shale plain to the north. In the vicinity of the streams outcrops and rocky talus slopes are present. The soil is characterized by greater fertility than the colder, moister soil of the shale region and for this reason the region is largely under cultivation.

The Saucon Valley between the hills of the South Mountain range is almost exclusively of limestone formation with a bit of shale, originally continuous with the formations of the Kittatinny Valley, and is little varied in topography, a lovely valley of mostly cultivated land framed by the hills of the South Mountain range.

On the south the county barely touches the "red sandstone, shale, conglomerate and trap" rocks of the Triassic Period of the Mesozoic Era.

The Lehigh River is the largest stream of the county. From Lehigh Water Gap to Allentown, where it is deflected eastward by a spur of the South Mountain, it flows through the shale and limestone country, and a number of clifflike outcrops and sharp rises of talus slope exist as the result of its erosion.

Several creeks, including Trout Creek, Rockdale Creek, Fells Creek, Spring Creek, and Coplay Creek, drain into it between these points, but about five-sixths of the drainage of the county is directed toward Allentown, where the combined Jordan Creek and Little Lehigh River discharge into the Lehigh.

The Jordan Creek has its rise at the base of the Bake-oven in the Kittatinny Range and has numerous branches within the shale region. In the limestone region, which it enters somewhere in the general vicinity of Guthsville, being deflected eastward here by the Huckleberry Ridge, a shale ridge, the Jordan Creek has practically no branches. Its valley from Guthsville northward is of great beauty, the tortuous windings of the river bed giving rise to ever changing vistas. The sharp rises are frequently clothed with hemlock and pine, sometimes in almost pure stands, and are usually beset with low clifflike outcrops along the water's edge as well as higher up the slopes. In the limestone region the stream is dry as far as Helfrich's Springs for a part of the year.

The Little Lehigh River rises in the South Mountains in Berks County and flows entirely within the limestone region within the county. With the exception of Trout Creek (the second of that name in the county), which empties the drainage of a part of the north slopes of the South Mountains into the combined Jordan-Little Lehigh at Allentown, all the drainage of the north slope of the main range of these hills within the county reaches this stream by its several tributaries. It is fed by numerous springs and some streamlets, having their sources in the limestone as well as the shale region, and has a strong and constant flow even in seasons of drought. Conifers are practically absent from the gentler wooded slopes of the valley of this stream, which lack the wilder aspect of the valley of the Jordan in the shale region.

These streams, together with the Saucon Creek draining the Saucon Valley into the Lehigh River in Northampton County, the Antelawny Creek already mentioned, and some streams reaching over the border into the county on the south, constitute practically all of the streams of importance in the county.

Many water courses of the shale region in general are dry in summer and there are comparatively few permanent moist areas of marshy or boggy character of any extent excepting along its contact with the formations of the Kittatinny Range. Along this range are many such areas, however. The limestone region in respect to such areas resembles the shale. On and in the vicinity of the South Mountains are a number of moist areas of boggy character, usually wooded or shaded by low growth such as alders.

A large proportion of the area of the county is given over to agriculture but there is a large percentage of woodland in the vicinity of the mountains. On the South Mountains the wood is cut at intervals but the new growth seems to develop quickly enough to hold the soil cover well and to restore original conditions with maturing growth. The forest cover of the mostly denuded slopes of the Kittatinny Range is usually rather thin excepting on the shelflike plateau along its base, which however is also frequently denuded, like all our eastern wood cover. Between the mountains the greater proportion of woodland is along the slopes of the streams but there are frequent scattered areas of woodland, especially in the shale region, increasing northward toward the mountains. The forest cover of the South Mountains and southward is practically purely deciduous in character, but northward conifers begin to appear in the limestone region, increasing northward, and at places in the shale region and in the vicinity of the Kittatinny Range equal and perhaps outnumber the deciduous trees.

As far as its flora is concerned, Lehigh County with reference to its zonal position must be included entirely within the Alleghanian area of the Transition.

In Bucks County, just south of Lehigh, and in the counties thence westward there occur areas where typical Carolinian species occur in association. These areas trend rather definitely eastward and westward, roughly parallelling the mountains, and mark the extension northward in that direction of typical Carolinian association. There are no such areas within Lehigh County.

As to its position with reference to the larger rivers of the region, the Delaware, the Schuylkill, and the Susquehanna, which partly flow within Carolinian territory and aid in the extension of Carolinian flora toward the mountains, Lehigh County lies between the Delaware and the Schuylkill. The Lehigh River is a large river but it is deflected eastward by the South Mountains to enter the Delaware without passing south of these hills. Its source is in Lehigh Pond in the "Poconos" of Wayne County, an area rich in species of normal Canadian association. Some of the species found in normal association in the mountains occur in the county along this stream.

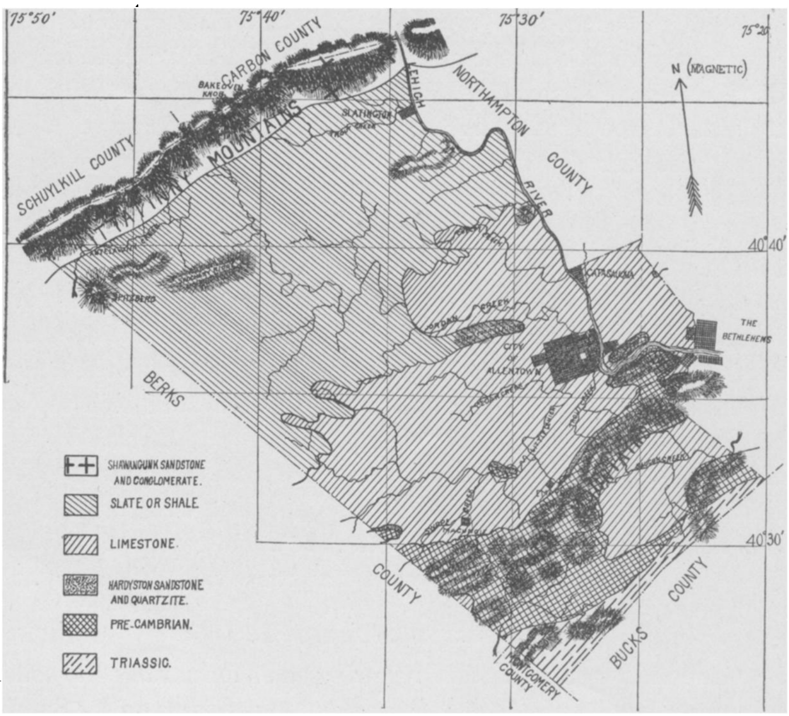
Glaciation, which has had such a marked effect on the flora of the corresponding region eastward, principally in New Jersey, is absent from the county. The extensive boggy areas characteristic of that region are not represented and many of the northern species found in association in these areas do not occur here.

The terminal moraine, where it crosses the Delaware River near Belvidere, New Jersey, and the Kittatinny Mountains a few miles west of Delaware Water Gap, is only about twenty miles distant from the county, and the proximity of the great ice sheet of the last glacial invasion must have had its influence on the flora of the county, or at least that portion lying within the Great Valley.

It would appear to a certain extent from its position that Lehigh County is so placed as to include within its boundaries many normally "southern" and "northern" plants. It is true that on account of these extensions the flora of the county is rich and that some species apparently have their limit of extension within the county, but it is doubtful whether Lehigh County equals in number of species any of the counties that bound it, with the possible exception of those to the north. This is an inference due to a review of some of the factors influencing the flora of this region, which have been briefly sketched. Thus, Berks, Montgomery, Bucks, and Northampton counties include within their boundaries many of the species of typical association in the mountains to the northwest, principally along the Delaware and Schuylkill rivers. All of these counties excepting Northampton are rich in extensions of Carolinian flora, which extends well up the river valleys. Northampton County shares with Lehigh the Lehigh River, and in addition its flora is enriched by the addition of a number of species associated with the glaciated region, besides such species as find their way into that county along the Delaware River. Whether the position of Lehigh County is unique with reference to the flora of the region when compared with these bounding counties will best be proven by future records. It has seemed sufficient to the writer to merely indicate such a possibility.

Lehigh County is probably represented in the older collections, but it might prove difficult to confirm some of the older records because Lehigh County was erected from Northampton on March 6, 1812, and enlarged in 1852 and 1859. A collection made by C. F. Beitel (approximately 1830–1865) is a part of the herbarium at Muhlenberg College, but it gives no dates or localities, though presumably partly collected in this region. There is a record of Elias Durand (1794–1873), the Philadelphia botanist, having botanized along the Lehigh River in the county. Among the Moravians there have always been some persons who were interested in botany. Among those who have visited the county in their collecting may be mentioned Rev. Lewis David de Schweinitz in the fungi, F. A. Wolle in fresh water algae, and Eugene A. Rau in the bryophytes. Mr. Rau's collections in the county have however not been confined to the bryophytes but include interesting records in the pteridophytes and spermatophytes. Dr. A. L. Huebener, of the Moravian Seminary, also collected in the region. His collection is a part of the Seminary herbarium. Prof. T. C. Porter also visited the county, though his list shows few records for the county. Dr. A. F. K. Krout, of Glenolden, Pa., resided in the Borough of Coplay in the county from 1869 to 1892 and refers to Capt. P. A. Lantz, of Saegersville, in the county as a coworker at the time. Dr. Krout collected actively during his residence in the county, and his collection, including some from the collection of Capt. Lantz, is now a part of the herbarium of the Philadelphia Botanical Club at the Academy of Natural Sciences at Philadelphia. Until his death several years ago, Dr. William Herbst, of Trexlertown, collected chiefly in the fungi. For severa years, during Dr. Philip Dowell's connection with Muhlenberg College, a large part of his leisure was given to collecting in the county. The writer acknowledges with pleasure his great indebtedness for his knowledge of field botany, especially in the pteridophytes, to Dr. Dowell, with whom he was usually associated on these excursions. Mr. D. W. Hamm, a student at that time and now a teacher, also an associate in field excursions, has retained his interest in the study. Mr. C. N. Lochman, who is associated in business with Mr. E. A. Rau in Bethlehem, is an active field worker who has frequently botanized within the county. Mr. C. C. Bachman is an active field botanist and has collected considerably in the county. Other botanists of adjoining counties have botanized within the county, and several visits by members of the Philadelphia Botanical Club have been made. The following residents of the county are likewise interested in our flora: Rev. Dr. J. A. Bauman, Messrs. M. S. Hartung and H. D. Bailey, and Rev. W. N. Kopenhaver.

In the following list, unless otherwise indicated, in every case where a station has been named, its exact distance is given in a carefully approximated direction from some name on the Topographical Maps of the U. S. Geological Survey, which cover all but a small portion of the county. The actual bog, streamlet, etc., may not appear on these maps but exists nevertheless and the above method is intended to standardize these citations and make the use of local terms subordinate. Distance from the City of Allentown has been given from the Center Square.



Map of Lehigh County, Pennsylvania.

PTERIDOPHYTA

In the following list the writer has attempted to present, with particular reference to Lehigh County pteridophytes, some observations that may be of more general interest. For the sake of brevity these observations have been reduced to a minimum. Stations have been mentioned for some of the rare or less frequent species and an attempt has been made to have the original discoverers of such stations receive the credit that is due them. In this connection it has not been thought necessary to mention more than the original collection from a station.

Material from practically all of the stations mentioned is in the herbarium of the writer as well as, in part at least, in that of other collectors. The inclusion of all the data would only increase the list unnecessarily. The exact measurements given are from herbarium material almost exclusively. They are used merely as a guide in connection with average or luxuriant growth. The figures in parenthesis following the length of leaf indicate length of stipe + length of blade. Herbaceous and evergreen are not to be taken too literally but serve to indicate comparative hardiness of the species. It is well known that sterile fronds in general outlast the fertile and it has not been thought necessary to indicate in every case the part protection plays in the apparent hardiness of a species. Seasons vary too with the years.

In general the pteridophytes of the county follow in relative frequency and abundance certain broad lines due to the distribution of habitats favorable to their growth. The term "the South Mountains" used in this connection is general and includes all of the hills of this range but refers particularly to the main ridge of these hills, about three miles southward from Allentown, called Lehigh Mountain, On some of the spurs and outlying hills of this range some species, like the spinulose wood ferns, become relatively less abundant, especially to the south within the county.

ADIANTUM PEDATUM L.

General in moist situations, growing on all formations and soils, but most abundant in boggy areas and along streams on the South

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NOTE: Where the collector's name is not given the specimens were collected by the writer.

Mountains. Rather frequent in moist situations on the talus slopes and at the bases of outcrops along the streams. On the wet "shale" formations along the Lehigh River, fronds 3.4 dm. long by 4.1 dm. wide with stipe 4.1 dm. long have been collected. This represents maximum luxuriance, the fronds in general being less luxuriant. Fruits late July and August. Herbaceous. withering early, but has been found in protected situations still green in November.

ANCHISTEA VIRGINICA (L.) Presl

Collected at a single locality along the Kittatinny Mountains north to west of Slatedale, August 9, 1909, *2104*.

It occupies an area of 20 feet in circumference, in practically pure association, in a low shallow depression filled with water for a part of the year but dry in summer. Also in somewhat similar habitat just south of this station along the public road running parallel to the mountain (October 10, 1909, *2285*), an area of rather limited extent, marshy for a part of the year but later drier, with sphagnum beds, etc., a duplicate of similar places along the range. It has not been found fruiting abundantly, a condition probably not normal as the writer has collected it near Saylorsburg in Monroe County, Pa., on July 25, heavily fruited and in abundance. Fronds 9.8 dm. (3.7 + 6.1) long and 2.6 dm. wide represent rather below average luxuriance. Herbaceous.

The frequent occurrence of this species in abundance along the coast and in association with Carolinian flora farther inland is to be expected, but still farther inland, especially in the mountainous region away from typical Carolinian association, its occurrence is always of interest.

ASPLENIUM EBENOIDES R. R. Scott

Lehigh County, in Porter's list. Helfrich's Springs, 1⅞ miles northwest by north of Allentown, 1901, *Hartung*. Along the Little Lehigh, 1½ miles southwest of Allentown, July 16, 1901, *Hamm;* December 8, 1907, *1063*. 2 miles southwest of Allentown, August 3, 1901, *97*. Along the Jordan, ½ mile west of Jordan Bridge, September 2, 1907, *856*. Along the Lehigh River, ½ mile below Ferndale, August 21, 1908, *1484*. Along Cedar

Creek in Dorney's Park, March 19, 1910, *2324*. Along the Jordan, 1¾ miles northwest of Kernsville, November 6, 1910, *3101*. Along the Little Lehigh, 1⅜ miles northwest of Emaus, December 22, 1907; November 24, 1910, *3137*.

All occur on limestone with the exception of *3101*, which was collected on shale.

As far as the writer has been able to ascertain, no less than 25 specimens of this fern have been collected in the county. The reader scarcely needs to be reminded of the abundance of the putative parent species of this hybrid in association in the county. These specimens have come from 7 stations, a station being defined for the purposes of this statement as some isolated area, wooded or not, separated by cultivated land from an adjacent station. Thus plants were taken at Helfrich's Springs at two places about one-third mile apart. No station as conceived by the writer is nearer to any other station than one-half mile. Of 6 plants left in the field, not included with the 25, 3 are known to have disappeared. All but 6 of the specimens noted are or have been a part of the writer's herbarium and represent all of the stations. Credit for finding a number of these is due to E. S. and W. Mattern, who have frequently been the writer's field companions. Some observations of interest with reference to this species have been made by the writer but would prove too lengthy for the purposes of this list.

ASPLENIUM MONTANUM Willd.

On rocks of Hardyston sandstone, southwest of Mountainville, on the South Mountains, Idlewild, 1872, *Krout;* January 25, 1908, *1073*. On "shale" along the Jordan Creek, 1¼ miles west to northwest of Kernsville, November 6, 1910, *3095*.

In fair abundance at both stations. Growing well shaded at both stations but less luxuriant at the first named than at the second, where fronds 17 cm. (8+9) long and 4.5 cm. wide have been collected and represent maximum luxuriance. Can be collected in July with old fronds still in good condition and new fronds starting to fruit but is in best condition in late fall. Evergreen.

The recorded stations for this species in New Jersey and Pennsylvania, limiting the southwest extension of the species from the mountains, are Delaware Water Gap in New Jersey, and in Pennsylvania, Easton, Northampton County, Lehigh County on the South Mountains,Chester, Lancaster, and York counties. Along the Lehigh River in Carbon County there are a number of stations.

ASPLENIUM RUTA-MURARIA L.

Near Helfrich's Springs, 2⅛ miles north by northwest of Allentown, 1882, *Krout*. Along the Little Lehigh, foot of 17th Street, Allentown, October 2, 1900, *Hamm*. 1¾ miles southwest of Allentown, October 21, 1900, *Dowell 1036*. 2⅛ miles southwest of Allentown, August 3, 1901. 1⅛ miles west by northwest of Emaus, December 22, 1907, *1064*. Along the Jordan, ⅜ mile east of Jordan Bridge, October 30, 1910, *3062*. Along the Little Lehigh, 1⅛ miles northwest of Emaus, November 24, 1910, *3140*. Near Salsburg Church, ⅜ mile north of the last, *3142*.

Occurs only on limestone in the valleys of Jordan Creek and the Little Lehigh, where it may be expected throughout. Not usually abundant excepting in the woods near Salsburg Church and at Helfrich's Springs, where quarrying has done much injury to the station. In shaded and exposed situations. Fruiting fronds 10 cm. (6+4) long and 3 cm. wide represent maximum luxuriance but fruiting fronds 2 cm. long have been collected. Fruits in July, but is at its best in fall. Evergreen well through the winter, especially the sterile fronds. The species varies in the shape and cutting of the pinnules or ultimate segments, from narrow and lacerate to broad or round-wedgeshaped and merely crenate or toothed. Apparently this species is to be expected on limestone in eastern Pennsylvania and on corresponding formations in northern New Jersey.

ASPLENIUM PLATYNEURON (L.) Oakes

General throughout, on all soils and formations and in all situations excepting wet ground. Frequently lining roadsides and railroad embankments in abundance but no less frequent and abundant in varying situations elsewhere. Sometimes growing in the clefts of rocky outcrops. Specimens with fronds 5.1 dm. (0.6+4.5) long and 3 cm. wide represent a fair average for luxuriant plants. Collected in fruit on June 26. Sterile and fertile fronds lasting well through winter but usually prostrate in November.

The writer knows of no species that is more evenly distributed in the county. On limestone and especially shale it tends to become serrate, and forms with not only some of the pinnae of the fertile frond serrate but the sterile also, are not rare. (On "shale" along Jordan Creek 1⅛ miles northwest of Kernsville, November 6, 1910, *3096*.)

Mr. E. S. Mattern found a plant on Hardyston sandstone along the Little Lehigh River, 1¾ miles west by northwest of Emaus, near Salsburg Church, which corresponds to the named variety *Hortonae.** This plant grew true for two seasons and when collected (July 17, 1908, *1351*) had three fronds of fertile form fully expanded, averaging 2.4 dm. (0.4+2) long and 3 cm. wide, but quite sterile, a correlated character of the variety as originally described.

ASPLENIUM TRICHOMANES L.

General on shale and limestone outcrops, not infrequently locally abundant. Has been recorded sparingly by the writer on Hardyston sandstone on the South Mountains 1¼ miles (March 28, 1908) and 1 mile (October 16, 1909, *2299*) southwest of Mountainville, and on Shawangunk sandstone at Lehigh Gap (January 19, 1908, *1069*). Fronds 19 cm. (3+16) long and 1.2 cm. wide represent maximum luxuriance, as do rosettes 17 cm. in diameter. Fruits in July. Evergreen.

In the county the species is "common" on the shale and limestone but rare on other formations. In the mountains to the north in the vicinity of the Lehigh River, the writer has found the species very infrequent.

ATHYRIUM ACROSTICHOIDES (Sw.) Diels

Frequent and abundant in boggy places and along streams on the South Mountains. Occurs on shale ⅛ mile south of Saegersville (July 7, 1907, *586*), along the creek ⅝ mile east of Hoffman (May 16, 1909), and at the base of the cliffs along the Lehigh River above Rockdale (May 16, 1909). Also in Lower Milford Township, 1⅜ miles southwest of Locust Valley, in the vicinity of a branch of East Swamp Creek (July 17, 1910, *2666*). It may be expected throughout. Fronds 9.8 dm. (3.5+6.3) long and 2.1 dm. wide represent average luxuriance. Heavily fruited in shade by August 6 but has been collected in fruit as early as July 13. Herbaceous.

**Asplenium ebeneum Hortonae* Dav. Rhodora 3: 1. *pl. 22.* 2 Ja 1901.

ATHYRIUM FILIX-FEMINA (L.) Roth

General throughout, on all soils and formations. Most abundant in the bogs and along streams on the South Mountains. Fronds 9 dm. (3.6+5.4) long and 2.8 dm. wide represent average luxuriance in one form of the species. It has been collected with mature fruit on July 2. Herbaceous. The variability of this species is well known.

BOTRYCHIUM DISSECTUM Spreng.

Not infrequent throughout, but most general and abundant on the South Mountains. Plants with fronds 10.5 cm. long and 18 cm. wide and standing 4.5 dm. high to top of fertile frond represent maximum luxuriance. One plant in fruit with blade 1.5 cm. long and 2.5 cm. wide standing 9.5 cm. high has been collected. Collected in fruit on August 25. Fertile fronds have been found still erect in November but are generally prostrate and withering at that time. Sterile fronds turning bronze red and lasting through the winter.

BOTRYCHIUM LANCEOLATUM (S. G. Gmel.) Ångs.

Vicinity of bog 1 mile south by southwest of Mountainville, September 25, 1909, *2248*. Back of Gruver's, along the third streamlet, 1⅜ miles east by northeast of Mountainville, September 25, 1910, *2984*. Above Idlewild, along streamlet at Mountainville, October 8, 1910, *3008*.

Collected only at these stations on the South Mountains. Only eight plants have been seen, the largest standing 16 cm. high. Attention is directed to the dates when the spores were in good condition as well as the comparative rarity of the plants. *B. neglectum* on these dates had entirely disappeared from the stations where it was earlier abundant.

All stations for this species are from counties in the mountains to the north and northwest, excepting the above and a record published in Torreya * by W. H. Leibelsperger for Fleetwood, Berks County.

BOTRYCHIUM NEGLECTUM Wood.

Second streamlet one mile east northeast of Mountainville, May 30, 1907, *D. W. Hamm;* same place and date, *349*. First streamlet 1 mile southwest of Mountainville, June 8, 1908, *1233*.

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*Torreya 7: 215. 19 N 1907.

Vicinity of spring near Waldheim, ½ mile southwest of Mountainville, June 13, 1908, *1248*. Vicinity of bog 1 mile south by southwest of Mountainville, June 14, 1908, *1259*. Second streamlet 1¾ miles southwest of Mountainville, June 28, 1908, *1302*. Abandoned ore pits west of above station, May 29, 1909, *1857a*. Near Gruver's, along third streamlet, 1⅜ miles east by northeast of Mountainville, June 15, 1910, *2545a*.

All of the stations are on the South Mountains. Inclined to abundance at the third, fourth, and sixth stations. A plant standing 2.7 dm. high has been collected and represents maximum luxuriance, though plants approaching these figures are not infrequent. A plant with the sterile segment 7.5 by 8 cm. has been collected and is closely approached by other plants in the writer's herbarium. Plants 8 cm. high with clearly defined characters have been collected. Has been found well out of the ground but not unfolded on April 11 and has practically disappeared late in July. Collected with ripe fruit on May 29. Variable with very suggestive forms.

BOTRYCHIUM OBLIQUUM Muhl.

The same remarks used in connection with *B. dissectum* apply also to this species. Specimens have been collected that exceed the measurements given under that species.

Both this and *B. dissectum* are very variable and forms suggesting intermediates have been collected. Sometimes varying in abundance locally, the habitats of both species appear identical, though certain forms of *B. obliquum* are apparently associated with the wet shaded bogs.

BOTRYCHIUM SIMPLEX E. Hitchcock

Near Gruver's, along third streamlet, 1⅜ miles east by northeast of Mountainville, June 15, 1910, *2545b*.

Plants collected at the above station have been referred to this species. Some doubtful material from another station, which may belong here, has been withheld. R. C. Benedict in a recent revision of the Botrychiums observes that they constitute "a complex group" and that "the question of specific limits is by no means settled." An active interest in the observations on this group has apparently developed, which will undoubtedly lead to a better understanding of the group and very probably affect a revision of this list materially.

BOTRYCHIUM TENEBROSUM A. A. Eaton

Along streamlet above Mountainville, July 4, 1900, *Dowell 830*.

Along second streamlet 1¾ miles southwest of Mountainville, July 13, 1907, *604*. Both stations are on the South Mountains. Edge of a bog, on a spur of the South Mountains along the Lehigh River, 1¼ miles northwest of Strassburg (S.E. Allentown), July 4, 1908, *1315*.

Practically absent from the original station detected by Dr. Dowell but still occurring sparingly at the stations later detected by the writer. It has been collected in good condition as early as June 6 and as late as July 24. At this time *B. neglectum* was withering or had disappeared. The third station was visited again on May 28 of this year [1910] and several plants were found coming up. Plants ranging from 4.5 cm. to 18 cm. in height have been collected. One plant with some portions of the sterile segment fruiting has been collected.

BOTRYCHIUM VIRGINIANUM (L.) Sw.

General throughout, on all soils and formations. Frequently abundant. The writer has a record of a plant standing 8 dm. high from ground to top of the erect sporophyl. This represents above maximum luxuriance, the plants in luxuriance being usually somewhat lower. Collected as early as May 30 but is mature in the middle of June. Herbaceous, the sterile segment lasting well into fall.

CAMPTOSORUS RHIZOPHYLLUS (L.) Link

On gneissic rocks, on a spur of the South Mountains, ⅞ mile northeast of Strassburg (S. E. Allentown), September 7, 1907, *898*. On gneissic rocks, Big Rock, 1 mile southeast of Mountainville, October 12, 1907, *1032*. On Hardyston sandstone, 1½ miles southwest of Mountainville, May 9, 1908. On gneissic rocks, Idlewild, Mountainville, 1909, *E. S. Mattern*. On gneissic rocks, Powder Valley, August 28, 1910, *2892*. On gneissic rocks, 1 mile southwest of Macungie, November 13, 1910, *3119*.

All of the above stations are on the South Mountain range.

Rare at the stations named above but so general and often so abundant on shale, and especially limestone, that any mention of stations on these formations would be useless. The species may occupy niches or grow in large patches on outcrops but is equally at home on loose talus in shade or in the open. It has not been found growing among moss on tree trunks, but with moss on some outcrops it suggests strongly epiphytic tendencies. Most luxuriant and freely proliferous in connection with moist, mossy situations on large talus or sometimes on outcrops. Fronds 4.2 dm. (1.1+3.1) long and 2.5 dm. wide represent maximum luxuriance. Fruits in August. Evergreen.

On limestone and shale the tendency to prominent auricles and undulate margins is very pronounced. Fronds very much incised have been collected. (On limestone, 1⅜ miles northwest of Emaus, January 1, 1908, *1068*.) Forking fronds with both tips proliferous have been collected. (On shale, ⅜ mile east of Jordan Bridge, October 30, 1910, *3065;* 1⅛ miles northwest of Kernsville, November 6, 1910, *3067*.) Also fronds with auricles lengthened and proliferous. (On limestone, 1⅝ miles north by northwest of Emaus, December 22, 1907, *1065;* on shale, ½ mile northwest of Kernsville, November 6, 1910, *3088*.)

CHEILANTHES LANOSA (Michx.) Watt

In fair abundance ½ mile northwest of Kernsville on an outcrop of shale along the Jordan facing south, May 9, 1909, *1765*. Fronds 2.3 dm. (0.9+1.4) long and 3.5 cm. wide represent average luxuriance. Fruits July. Evergreen, lasting well through the winter.

Apparently this is not a rare species in the counties to the south of Lehigh but this is one of the stations limiting the extension of the species toward the mountains.

DENNSTAEDTIA PUNCTILOBULA (Michx.) Moore

General throughout, a frequent species of roadsides and edges of woodlands, clearings, etc. In the mountains frequently abundant in open sunny places in the woods. Sometimes growing from niches or crevices on outcrops. Fronds measuring 8.3 dm. (1.8+6.5) long and 2.1 dm. wide represent maximum luxuriance. Collected in mature fruit on July 12. Herbaceous, but has been found still green in November.

DRYOPTERIS BOOTTII (Tuckerm.) Underw.
D. cristata × *intermedia* Dowell

One-fourth mile south of Saegersville, July 7, 1907, *535*. In bog and along streamlet 1⅞ miles southwest of Mountainville, August 3, 1907, *704*. Near Waldheim, ½ mile southwest of Mountainville, October 16, 1909, *2287*. General vicinity of bog 1 mile south by southwest of Mountainville, November 12, 1910, *3107*. Along streamlet ⅜ mile east of Shimersville, November 13, 1910. *3128*. Vicinity of streamlet 1⅜ miles southeast of Emaus, November 13, 1910, *3134*.

Approaching anything like abundance in only a limited boggy area near Saegersville, the only station noted in the county outside of the vicinity of the South Mountains. Not rare, neither inclined to abundance at the other stations, which would indicate that this species is to be expected in bogs on the South Mountains and elsewhere in association with the other related members of the *Dryopteris* group. Fronds 9.1 dm. (2.7+6.4) long and 1.5 dm. wide represent maximum luxuriance. Collected with ripe fruit on June 28. Sterile fronds evergreen, the fertile lasting well into winter. Variable.

DRYOPTERIS CRISTATA (L.) A. Gray

Lehigh Mountain along Lehigh River, 2 miles southwest of Bethlehem, September 1878, *E. A. Rau*. Streamlet above Mountainville, August 8, 1900, *Dowell 903*. Third streamlet 1⅜ miles east northeast of Mountainville, September 15, 1900, *Hamm*. Bog ⅛ mile south of Saegersville, July 7, 1907, *536*. Bog and streamlet 1⅞ miles southwest of Mountainville, July 13, 1907, *615a*. Bog west of Trexlertown, November 14, 1908. Near Waldheim, ½ mile southwest of Mountainville, October 16, 1909. Vicinity of woods and creek 1⅜ miles southwest of Locust Valley, July 17, 1910, *2667*. Vicinity of bog 1⅞ miles east by northeast of Mountainville, October 1910, *H. D. Bailey*. Vicinity of mine holes ½ mile northeast of Lanark, November 5, 1910, *3074*. 1¼ miles south of Schnecksville, November 6, 1910, *3076*. 1⅛ miles south by southeast of Mountainville, November 12, 1910, *3104*. Bog and streamlet 1 mile south by southwest of Mountainville, November 12, 1910, *3108*; farther west, *3109*. Roadside, south to southwest of Macungie, November 13, 1910. Streamlet ⅜ mile east of Shimersville, November 13, 1910, *3129*; streamlet 1⅜ miles southeast of Emaus, same date, *3132*.

This species is of such frequent occurrence on the South Mountains that it may be expected throughout in wet boggy situations, though apparently absent from some areas and portions of others. It is abundant at the Saegersville station, where, growing in a deep shaded boggy area, it inclines to luxuriance as it does at places on the South Mountains. Found in open as well as shaded situations. Fronds 8.8 dm. (3.2+5.6) long and 1.3 dm. wide represent maximum luxuriance. Fruits late in June. Sterile fronds evergreen, the fertile lasting into late fall or early winter. Variable.

DRYOPTERIS CRISTATA×MARGINALIS Davenp.

General vicinity of streamlet at Mountainville, 1900, *Hamm.* Streamlet ½ mile east of Mountainville, June 22, 1901, *74*. In bog and along streamlet 1⅞ miles southwest of Mountainville, July 13, 1907, *615a*. Boggy area ¼ mile south of Saegersville, June 20, 1908, *1272b*. General vicinity of bog 1 mile south to southwest of Mountainville, November 12, 1910, *3111*; corresponding area about ¼ mile west, *3114*. Along road about ⅞ mile south to southwest of Macungie, November 13, 1910, *3115*. Vicinity of streamlet 1⅜ miles southeast of Emaus, November 13, 1910, *3133*.

This hybrid, as the stations show, is widely distributed on the South Mountains and it is quite safe to say that it may be expected throughout in favorable habitats where its putative parents are present. Rare at all of the stations, though at some of the stations on the South Mountains a number of plants are present. Mostly in shade but has been collected in the open. One fertile frond 10.4 dm. (2.7+7.7) long and 2.3 dm. wide has been collected but represents rather above maximum luxuriance. Fruits late in June. Fronds early prostrate, the sterile of some plants lasting well through the winter. Fertile fronds perhaps hardier than those of *D. cristata*.

In general the fronds collected in the county have been remarkably regular in outline and usually offer little difficulty in identification in the field. Material collected previous to August, 1907, by Mr. Hamm and the writer, lay undetected and not definitely assigned until identified by Dr. Dowell, who visited the writer at that time for the purpose of collecting this hybrid growing in the open. While the measurement given is unusual, clumps of this hybrid occur in which the fronds incline to luxuriance and do not fall far short of these figures.

DRYOPTERIS GOLDIANA (Hook.) A. Gray

Boggy area and along streamlet 1¼ miles northwest of Strassburg, *Krout;* July 14, 1907, *639*. Along streamlet 1⅜ miles southwest of Locust Valley, *I. S. Moyer;* September 12, 1909, *2185*. Along streamlet 1 mile south by southeast of Spring Valley, May 15, 1900, *C. N. Lochman.*

Gaining in abundance at the first named station and fairly abundant at the second, where the trees have been cut from the low area on which the species grows. The second station, discovered by Dr. I. S. Moyer, the Bucks County botanist, is that of the published record in the Bucks County lists. The station is very close to the county line but in Lehigh. Bucks has however an authentic record of this species from Buckwampum. One frond 11.9 dm. (4.8+7.1) long and 5.5 dm. wide, representing rather above maximum luxuriance, has been recorded from the first station, where however the species rather inclines to luxuriance. Collected with mature fruit on July 4. Herbaceous, withering early but still green in November, though usually prostrate at that time.

Apparently, this species is local in its distribution in this region.

DRYOPTERIS INTERMEDIA (Muhl.) A. Gray

General throughout, on all soils and formations in moist situations, sometimes in niches on rocks and outcrops. Frequent and most abundant on the South Mountains. Fronds 6.6 dm. (2.1+4.5) long and 2.6 dm. wide represent average luxuriance. Collected with ripe fruit on June 20. Evergreen, lasting through the winter but early prostrate.

DRYOPTERIS INTERMEDIA × MARGINALIS Benedict

A fine plant of this hybrid was discovered in a low, moist shaded area in the vicinity of the abandoned mine holes along

Saucon Creek, ½ mile northeast of Lanark, November 5, 1910, *3073*.

DRYOPTERIS MARGINALIS (L.) A. Gray

General throughout, on all soils and formations and in many situations. Frequently abundant. Often in niches and fissures on outcrops. Frequently a roadside species in the vicinity of woods. Fronds 8.9 dm. (2.9+6) long and 2.8 dm. wide represent average luxuriance. Collected with ripe fruit on July 4. Evergreen but mostly prostrate by November. Variable.

DRYOPTERIS NOVEBORACENSIS (L.) A. Gray

General throughout, but most abundant on the South Mountains, where the species sometimes occupies areas of limited extent in almost pure association in the rich woods. Fronds 5.7 dm. (0.8+4.9) long and 1.5 dm. wide represent maximum luxuriance. Fruits in July. Herbaceous, withering early.

DRYOPTERIS SPINULOSA (Müll.) Kuntze

General throughout, associated with *D. intermedia.* Most abundant on the South Mountains, where it occurs in association with *D. intermedia*, but never even approaches this species in abundance. In general not nearly as luxuriant as the latter species. Collected in fruit on June 14. Tender, evergreen, mostly turning yellow early, but some fronds lasting well toward winter.

This and *D. intermedia* are very variable and, approaching each other closely, offer great difficulty in identification. Dr. Dowell has collected forms (general vicinity of bog 1 mile south by southwest of Mountainville, August 25, 1907, *Dowell 5112*) that are undoubtedly hybrids. These specimens, and material apparently identical with them in the writer's herbarium (*803*), have been referred here. Material from along the Kittatinny Mountains in the vicinity of Bake-oven Knob (June 21, 1908, *1284b*) has also been referred here. This intergrading of the species probably affects the comparative hardiness of the species, an associated character well marked in typical forms.

DRYOPTERIS THELYPTERIS (L.) A. Gray

General throughout. May be expected usually in abundance in all marshy meadows throughout and in favorable habitats elsewhere. Varying greatly in length of stipe according to situation. Fronds 7.8 dm. (4.3+3.5) long and 1.4 dm. wide represent average luxuriance. Collected with ripe fruit on August 4. Herbaceous, withering early.

FILIX BULBIFERA (L.) Underw.

Moist limestone cliffs, Helfrich's Springs, 2⅛ miles west by northwest of Allentown, June 21, 1901, *Dowell, 1124.*

Moist hillside ½ mile west of Jordan Bridge, July 17, 1901; September 2, 1907, *849.* Moist shale cliffs ½ mile east northeast of Rockdale, August 15, 1908, *1442.*

On the wet shale cliffs in the vicinity of Rockdale along the Lehigh River, and northwest to below Slatington, this species is not rare. At the Jordan Bridge station it grows abundantly in the open on the moist limestone talus slope, but elsewhere in generally shaded situations. It may be looked for elsewhere in similar situations on these formations. Fronds 5.4 dm. (1.3+4.1) long and 1 dm. wide represent average luxuriance. Fruits in July. Herbaceous, withering early.

FILIX FRAGILIS (L.) Underw.

Lehigh Mountain, *Krout;* Laurel Hill, *Krout.*

Along first streamlet ½ mile east of Mountainville, June 8, 1900, *Hamm.* Wet situation along road ⅝ mile northwest of Strassburg, May 4, 1907, *Hamm;* May 18, 1907, *252.* ¼ mile south by southwest of Kernsville, April 25, 1908, *1078.* Wall of race, Helfrich's Springs, 1⅞ miles northwest by north of Allentown, May 5, 1908. Roadside 1 mile west of Emaus, May 24, 1908. Shale cliffs ½ mile east of Rockdale, April 9, 1910. Shale cliffs 1¼ miles southeast of Slatington, May 5, 1910, *2402.* ½ mile northwest of Kernsville, November 6, 1910.

Not rare at any of the stations given and often abundant. A frequent species on the shale cliffs from below Rockdale to below Slatington. May be expected in moist situations on the outcrops of these formations. Fronds 2.7 dm. (1.2+1.5) long and 7.5 cm. wide represent average luxuriance. Fruits late in May. Herbaceous, withering early, but fresh growth late in the season often lasting well into fall.

(?) LYGODIUM PALMATUM (Bernh.) Sw.

The published record for Lehigh County for this species is based on a specimen in the herbarium of the Philadelphia Botanical Club bearing a label which reads Carbon, Lehigh County. There is no Carbon in Lehigh County and Dr. Krout was very glad to correct this error when it was brought to his attention. The plant had been given to him. Mr. E. D. Leisenring reported this fern to Dr. Krout as occurring on the South Mountains south of Mountainville and a trip was made to locate this station. The fern was not found and though the habitat is promising, it likely never occurred in the county.

The species occurs at a number of stations over the Pocono plateau and its extensions, from Monroe through Carbon and Luzerne counties as far as Schuylkill, with a record from Wyoming still farther north. It occurs also in Bucks and Philadelphia counties in Pennsylvania and at a number of stations in New Jersey, all however in the Carolinian. The only connecting station is apparently the one based on a specimen collected by Knipe at Delaware Water Gap in the herbarium at the Academy of Natural Sciences at Philadelphia. The distribution of the species in this general region is not without interest.

MATTEUCCIA STRUTHIOPTERIS (L.) Todaro

This record is now chiefly of historical interest. Dr. A. F. K. Krout found the species well established at several places in the "Lowlands" along the Lehigh River at Coplay, but all were destroyed while he still continued a resident of the county, by the slag dumps of local iron furnaces. The stations in Northampton County along Hokendauqua Creek and near Nazareth have also disappeared.

The species is not rare in cultivation at Allentown, and recently the writer saw it planted about a Slatington residence. It is not unlikely that it may still exist in some isolated habitat in the county. The species is recorded southward at stations along the Delaware and can still be collected at places along this stream in Northampton and Bucks counties in Pennyslvania.

ONOCLEA SENSIBILIS L.

General throughout, growing in shade and in the open on all soils and formations. Has been recorded in one instance from a shaded bog as "waist high" or approximately 1 m., which is rather over maximum luxuriance. Fruits late in July. Herbaceous, early withering, the fertile fronds persistent through the winter.

The *obtusilobata* form has not been collected but may be looked for with the type.

OSMUNDA CINNAMOMEA L.

General throughout, in moist or wet situations. Most abundant in the vicinity of the Kittatinny and South Mountains where in the bogs it not infrequently attains a height of 1.74 m. Fruiting by the middle of May but has been recorded as early as May 2. In the open, plants with 15 fertile fronds have been noted while 8 to 10 are not infrequent. Fertile fronds less abundant in shade. Herbaceous, the pinnae which are variable in outline early withering, the stipes persistent.

The *frondosa* form has been collected. (On the South Mountains along the Lehigh River, May 12, 1899, *Hamm.*)

OSMUNDA CLAYTONIANA L.

General throughout, but preferring drier situations than *O. cinnamomea*, though occasionally associated with it. Reaching the height of 1 m. in luxuriance, but usually lower in height than *O. cinnamomea* when associated with that species. A frequent species of the wilder roadsides and in such situations sometimes abundant. Fruiting with *O. cinnamomea* and herbaceous as in that species.

OSMUNDA SPECTABILIS Willd.

General throughout, in wet situations. Most abundant in bogs and marshes in the vicinity of the Kittatinny and South Mountains. Approximately 1 m. in height in luxuriance. Fruits in general later than *O. cinnamomea*, with which it is frequently associated. Herbaceous.

PELLAEA ATROPURPUREA (L.) Link

Though absent from some outcrops this species is so frequent on limestone and shale outcrops that it is to be expected everywhere in the county on outcrops of these formations. Along the little Lehigh and Cedar creeks it is frequent on limestone and as far as the vicinity of Jordan Bridge along the Jordan. On the shale outcrops along the Jordan it is not infrequent but less abundant. On the limestone and shale outcrops along the Lehigh River it is present rather abundantly not only in the county but as far as Easton in Northampton County and Phillipsburg in New Jersey. At the former place it may be seen growing on a wall along a street near the Central Railroad of New Jersey station, and at Lehigh Junction, Phillipsburg, it grows abundantly on walls enclosing the stairway to the overhead railroads.

In the county it is also perfectly at home and often occupies chinks in the walls of abandoned limekilns, railroad abutments, etc. The manner in which it has occupied comparatively recently abandoned limestone quarries stamps it as a permanent resident in the county.

It grows practically in shaded as well as open situations, and in exposed situations can often be found withered in seasons of protracted drought. The size of the fronds is due to exposure and lack of moisture no less than peculiar situations that make a longer stipe necessary. Fertile fronds 7 cm. (3+4) long and 2 cm. wide are not infrequent and fronds 4.1 dm. (1.6+2.5) long and 1.1 dm. wide have been collected. Has been collected well fruited on July 10. The species is evergreen. In severe cold weather the pinnules shrivel but are not dropped from the stalk.

PHEGOPTERIS HEXAGONOPTERA (Michx.) Fée

All of the writer's records are from the South Mountains but it is likely that this species occurs in the vicinity of the Kittatinny Range as well as elsewhere. A record of P. A. Lantz for Saegersville, September 25, 1875, would mean shale formation, if the species was actually collected at that place. If the writer has seen it on shale or limestone the fact has escaped him. It is a frequent and often abundant species in shaded and open situations on the South Mountains and appears equally at home in wet or drier situations. Sometimes it occurs in patches of pure association in the more open woods. Fronds 5.6 dm. (3.6+2) long and 2.3 dm. wide represent average luxuriance. One frond from a moist situation, 7.2 dm. (4.6+2.6) long and 2.9 dm. wide, has been collected.

Collected with ripe fruit on August 1. Herbaceous, withering early.

Forms occur in the bogs or along the streams on the South Mountains which simulate closely the characters of *P. Phegopteris*. It has been suggested that farther south the species intergrade, and perhaps some such forms exist here.

PHEGOPTERIS PHEGOPTERIS (L.) Underw.

General and often abundant on the moist shale cliffs along the Lehigh River from Cementon to near Slatington. Laurel Hill, 1878, *Krout;* Cementon, July 11, 1908, *1325;* Rockdale, August 15, 1908, *1468*. Fronds 3.9 dm. (2.6+1.3) long and 1 dm. wide are rather below average though the fronds are never very large. Collected with ripe fruit on July 11. Herbaceous, withering early.

POLYPODIUM VULGARE L.

Frequent throughout, on outcrops of all formations. It has been found growing in the cleft trunks of trees and occasionally on loose talus. Less abundant on limestone but on rocks in the mountains, and especially on the shale outcrops it is often very abundant, not infrequently in pure association. Varies greatly in size according to situation. Most luxuriant in rich leaf mold on the shelves of outcrops, and in such situations frequently 3.4 dm. (1.2+2.2) long and 7 cm. wide, which represents average luxuriance. Fruits in summer, is evergreen and may be collected well into winter, when severe cold causes the fronds to roll up to decrease radiation. In general constant to type but with variations probably referable to certain described forms or varieties.

POLYSTICHUM ACROSTICHOIDES (Michx.) Schott

Frequent throughout, on all soils and formations and in all situations, but most abundant in moist (not wet), often rocky situations on wooded hillsides and along small streams, and in the vicinity of shaded bogs in woods. Also a frequent roadside species in the vicinity of woods. Fertile fronds 7.9 dm. (2.6+5.3) long and 1.2 dm. wide have been collected and represent average luxuriance. Fruits in July. Evergreen but prostrate in November when the fertile portion of the frond is usually withered. The species is very variable in the cutting of the pinnae, and the varieties *Schweinitzii* and *crispum* occur with the type.

PTERIDIUM AQUILINUM (L.) Kuhn

In the vicinity of the mountains in open situations but not infrequently in woods in shade. Usually abundant over large areas. In favorable habitats as high as 1 m. but usually lower, especially in drier, less open situations. Has been collected heavily fruited on July 4. Herbaceous but lasting well into fall, the dried plants persistent into winter.

It is not unusual to find that "common" species like this are slighted in observations. When the writer began this list he found he had taken a number of records for this species, but they were all of the mountains where sandy soil formation are the rule. It was too late to follow up the particular observation that suggested itself and which the reader will suspect. The writer does not believe in presuming too strongly on observations so he will ask the question: Does this species prefer sandy soil formations and does it avoid any others? Since this question has arisen in the writer's mind he has tramped for miles in shale and limestone country in the county and has found the brake absent from numerous favorable habitats. He has found it sparingly at two places on shale. None was seen for miles along the upper Jordan Creek. Does the soil have anything to do with the relative frequency and abundance of this species?

WOODSIA ILVENSIS (L.) R. Br.

This species was collected in 1878 by Dr. A. F. K. Krout, near Kernsville, on shale outcrops along the Jordan. On a trip undertaken to confirm this record, for which a specimen exists, this species was found fairly abundant on the outcrops ½ mile northwest of Kernsville, May 9, 1909, *1763*, and since then it has been found still further up stream 1⅛ miles northwest of Kernsville, November 6, 1910, *3098*. The outcrops are shaded, at least in part, and the species, which is fairly abundant, is inclined to luxuriance beyond the average. Fronds 1.9 dm. (0.7+1.2) long and 3 cm. wide are little above average luxuriance. Collected heavily fruited on June 26. Herbaceous, but green fronds have been collected as late as November 6.

WOODSIA OBTUSA (Spreng.) Torr.

Of frequent occurrence and often abundant on the shale and limestone formations, especially on outcrops and in rocky woods along the Jordan Creek and the Little Lehigh River. It may be expected throughout on these formations. Recorded on the South Mountains from Lower Milford (Krout), along the Lehigh River (May 19, 1900, *Lewis A. Ink*, in Muhlenberg College herbarium), and Vera Cruz (February 22, 1908). There is no record from the Kittatinny Mountains. Very abundant ½ mile northwest of Kernsville along the Jordan. Grows in the open and in the shade. Fertile fronds 4.1 dm. (1.5+2.6) long and 6 cm. wide represent average luxuriance. Collected well fruited on June 26. The sterile fronds are half evergreen and in "rosettes" last well over winter.

EQUISETUM ARVENSE L.

Common in about the frequency and usual great abundance for this general region. Fruits in early spring. (April 13, 1907, *149*.) Herbaceous.

EQUISETUM FLUVIATILE L.

Occurs in great abundance often in patches of practically pure association, in wet situations in the low meadows along the Little Lehigh, from opposite 10th Street, Allentown, westward as far as 12th Street (May 30, 1900, *Dowell 799*), and at the mouth of Cedar Creek (*E. S. Mattern*). Also shores of the Lehigh River, near Slatington (*Krout*), and 1½ miles east by southeast of Allentown along the canal (October 3, 1909). Fruiting plants 8.2 dm. and sterile plants 9.5 dm. high represent average luxuriance at the first named station, where the plants grow in the open and fruit abundantly in May (May 28, 1909, *1849*). Herbaceous, withering early.

EQUISETUM HYEMALE L.

Not infrequent in woods along the Jordan Creek and Little Lehigh River. Also at Coplay (*Krout*) and in abundance within a limited area between the canal and the Lehigh River, approximately 2 miles east of Allentown (December 5, 1908.) 1 m. in height at this station but lower elsewhere. Collected fruiting in fall (½ mile west of Jordan Bridge, October 6, 1901, *Dowell 1329*) but not in early spring. Evergreen.

The species is the form typical for the region, described as *E. hyemale affine* (Engelm.) A. A. Eaton.

EQUISETUM SYLVATICUM L.

Infrequent in the bogs on the South Mountains, where it is rare in fruit. Very abundant and freely fruiting in an open marsh southeast of the Bake-oven Knob on the Kittatinny Range (April 30, 1910, *2357*) and presumably present elsewhere in the vicinity of this range. Sterile plants 5.3 dm. high represent average luxuriance. Collected in fruit on April 30. Herbaceous, withering early.

LYCOPODIUM CLAVATUM L.

In the general vicinity of the bog 1 mile south by southwest of Mountainville, on the South Mountains, there are three places where this species has been found (October 5, 1907, *1007*), and it has also been collected 1 mile south by southeast of Mountainville (March 6, 1910; November 12, 1910, *3102*). It occurs sparingly near a moist open area in a quarrylike exposure of Hardyston sandstone, on the spur of the South Mountains along the Lehigh River, 5/8 mile northeast of Strassburg (May 31, 1908; October 29 1910, *3049*). It is nowhere abundant and has not been found in fruit. Evergreen.

This species is not infrequent, often abundant and usually well fruited, in the mountains near Mauch Chunk in Carbon County and near White Haven in Luzerne County, to the northwest, but has been seen nowhere in Lehigh County growing in these apparently normal conditions. Though the species has been collected well to the southeast of the mountains, in Pennsylvania, it can be said to be an infrequent or even rare species in Lehigh County.

LYCOPODIUM COMPLANATUM L.

General throughout, but local in its occurrence and frequently abundant. Growing in open and shaded situations and on all soils and formations. Less frequently fruiting but usually more luxuriant in shade than in the open. Fruits late in August. Evergreen.

The species is the form typical for the region, described as var. *flabelliforme* Fernald.

LYCOPODIUM INUNDATUM L.

In an open, sandy, springy bog at the head of Black River, 1⅞ miles east by northeast of Mountainville, on the South Mountains, southeast of Allentown, July 27, 1900, *Dowell 860;* Kittatinny Mountains, north of Lehigh Furnace, September 22, 1907, *967;* and north of Slatedale, September 22, 1907, *977;* moist area in quarrylike exposure of Hardyston sandstone on Lehigh Mountains, along Lehigh River, between the road and railroad ⅝ mile northeast of Strassburg, October 29, 1910, *3041.*

Rare excepting at the station north of Lehigh Furnace, which consists of a very limited boggy area heading a rivulet, where a spring seeps out over an old lumber trail. In the cold sphagnum and grass the plant is found. The habitats at the other stations are similar. All are on sandy soil formation and are indifferent to shade, growing equally well without the protection of grasses, etc. Trailing stems sometimes branched, in luxuriance 9 cm. long with fruiting stems 9 cm. high. Fruiting stems less than 4 cm. high have been collected.

Apparently the only records for this species in Pennsylvania south of the Kittatinny Range are from Lehigh County.

LYCOPODIUM LUCIDULUM Michx.

Frequent and usually abundant, sometimes in patches of pure association, in cold shaded bogs and similar situations along streamlets, on the Kittatinny and South Mountains. Not infrequently very abundant locally. Has been collected in the vicinity of a cold shaded springhead on "shale" along the Jordan Creek, 1¼ miles west to northwest of Kernsville, November 6, 1910, *3094,* and farther up stream it occurs sparingly on the moist wooded slopes facing north. Sometimes luxuriant, exceeding 2.3 dm. in height, but usually between 1 and 2 dm. high. Freely fruiting in fall. Evergreen.

LYCOPODIUM OBSCURUM L.

A frequent species on the Kittatinny and South Mountains, often locally abundant. Apparently less frequent on limestone and shale but to be expected throughout. Plants 2.4 dm. high are rather above average luxuriance. Collected in ripe fruit from late August to late November. Evergreen.

SELAGINELLA APUS (L.) Spring.

General throughout, in moist, springy and often marshy, open meadows and bogs. Usually abundant. Collected on wet "shale" outcrops along the Jordan Creek, 1⅛ miles northwest of Kernsville, November 6, 1910, *3100*. Collected in fruit on August 25. A conspicuous species in late fall and early winter among the grasses in the open meadows. Evergreen. Has been found in January apparently as fresh and untouched by the cold as earlier in the season.

ISOËTES CANADENSIS (Engelm.) A. A. Eaton

Collected along the Lehigh River, about a mile above Bethlehem, in August, 1882, *Eugene A. Rau*. This plant, which Mr. Rau has told the writer was originally collected by Elias Durand, the Philadelphia botanist, on a trip up the Lehigh River, was referred to "*I. Engelmanni* A. Br." but changed later. A note on Mr. Rau's label refers to the TORREY BULLETIN for June, 1903.*

In this list variation has not been especially emphasized. The writer has collected in the county many forked fronds of ferns of different species, plants of *Botrychium obliquum* Muhl. with two or even three fertile fronds, etc., which may be considered abnormal growths and of which it is unnecessary to make any particular mention.

What has been said in reference to the Botrychiums applies even better to the genus *Dryopteris* or more properly to that division characterized as the *cristata-marginalis-spinulosa* group. Contributions concerning the hybrids of this group are to be found in current botanical literature. These contributions contain also many observations relating to the described species themselves and materially advance the knowledge of the group. All of the members of the group indigenous to this region, excepting *D. Goldiana*, which is rather local, are to be found more or less evenly distributed in a number of habitats in the South Mountain range. In view of the acknowledged difficulty of the group, with particular reference to its hybrids, the writer has made little mention of the variation to be found. As to the identity of the material cited, the writer

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*Bull. Torrey Club **30**: 359–362. 11 Je 1903.

is especially glad to make grateful acknowledgment to Dr. Philip Dowell for examining all his collections in this group.

SUPPLEMENTARY NOTES

Some notes on the following species, which may be called "near neighbors," may be of interest:

Asplenium pinnatifidum Nutt. Judging from published records, the collection of this species in the county would be not only surprising but unexpected.

Athyrium angustifolium (Michx.) Milde. Reported among other counties in Pennsylvania from Berks, Montgomery, and Monroe. Its occurrence within the limits of the county would not be surprising.

Dryopteris Clintoniana (Eat.) Dowell. Accepting the published records for this species without questioning the identification, it is possible that this species may yet be collected in the county.

Dryopteris simulata Davenp. Porter records this species from Schuylkill, Pike, and Monroe counties, in the mountains to the north, and the writer has found it abundant on Broad Mountain, near Mauch Chunk, in Carbon County, and near Saylorsburg in Monroe County. It has also been reported from Bucks County, and southeast in New Jersey. The writer has recognized the possibility of the fern occurring in the county but careful search has not resulted in finding it.

Lorinseria areolata (L.) Underw. The only excuse for mentioning this species is the published record for Monroe County, Pennsylvania. Normally this is a coastal species with few records of its occurrence far inland. Apparently Carolinian in its association, its occurrence in the county is not expected.

Ophioglossum vulgatum L. There are records for this species from nearly every county adjoining Lehigh but the writer has looked over many favorable localities with the species in mind without favorable result. Its occurrence may almost be assumed but its collection will probably be accidental, like so many of the records of this species.

Phegopteris Dryopteris (L.) Fée. There is every reason to believe that this species should occur in Lehigh County, as it is reported from so many of the adjoining or neighboring counties, but thus far it has not been collected.

Lycopodium annotinum L. This species has been collected by the writer at an altitude of approximately 400 m., in a ravine on Broad Mountain, near Nesquehoning, Carbon County, facing south. Porter collected it in the Poconos, and its extension southeast along the Kittatinny Range is not unreasonable.

Lycopodium tristachyum Pursh. There are apparently no records for this species in eastern Pennsylvania southeast of the mountains, but in the Flora Cestrica, under the species *L. complanatum*, occurs the following footnote:

"Obs. My friend, JOSHUA HOOPES, finds specimens on our slaty hills, which he regards as almost specifically distinct,—having trailing *stems* mostly buried and rhizome-like, the *branches* of a brighter green, the ultimate *branchlets* not so coarse, and twice as numerous, while the *spores* are matured two or three months earlier than the common form."

What was this plant that Joshua Hoopes observed in Chester County, Pennsylvania? The seventh edition of the Gray Manual gives the range of this species as "Me. to Del., etc." Its occurrence in the county would not be surprising.

Selaginella rupestris (L.) Spring. Records show this species to occur in Pike, Monroe, Northampton, Berks, Chester, Lancaster, and Bucks counties in Pennsylvania. There is as yet no record for Lehigh.